

**I Claim:**

1. A method of using a hydrogen containing gas as a fuel, a component of a fuel, a fuel additive or an additive for mixing with a fuel for hydrogen assisted  
5 combustion in a compression engine characterised in that the hydrogen containing gas is a gas blend or mixture produced by a hydrogen generator and comprises hydrogen and at least one other material produced in the hydrogen generation process at the same time as the hydrogen is  
10 generated including the steps of:  
    using the hydrogen generator to produce the hydrogen containing gas blend or mixture;  
    reducing the temperature of the gas blend by passing the gas blend through a heat exchanger;  
15      introducing the gas blend or mixture to a compression engine as one component of the fuel; and  
    combusting the fuel in the engine, wherein the relative amounts of the hydrogen and of the at least one other material of the gas blend or mixture are selected  
20 in accordance with the nature of the at least one other material and the requirements of hydrogen assisted combustion of the engine.
2. A method of operating a hydrogen generation apparatus to produce a hydrogen containing  
25 gas, blend or mixture, suitable for use as a fuel, a fuel component or a fuel additive characterized in that the hydrogen containing gas blend or mixture contains hydrogen and at least one other component that is produced in the process at the same time as the hydrogen  
30 is produced by a hydrogen generator wherein the operating parameters of the hydrogen generating apparatus are adjusted to provide a preselected or predetermined composition of the gas blend or mixture suitable for use in hydrogen assisted combustion of a compression engine  
35 in which the respective amounts of the hydrogen or other

component or components are selected in accordance with the nature of the other component or components and with the requirements of an engine to which the gas blend or mixture is introduced in order to facilitate hydrogen  
5 assisted combustion of the engine thereby increasing the efficiency and/or performance of the engine.

3. A method of producing at least one component of a fuel for hydrogen assisted combustion of a compression engine in which the fuel includes a hydrogen  
10 containing gas characterised in that the hydrogen gas is a gas blend or mixture produced by a hydrogen generator and comprises hydrogen and at least one other material that is produced along with the hydrogen in the hydrogen  
15 generation at the same time the hydrogen is generated including the steps of producing the hydrogen containing gas blend or mixture, cooling the gas blend or mixture by passing the gas blend or mixture through a heat exchanger, introducing the cooled gas blend or mixture  
20 into the compression engine as at least one component of the fuel wherein the relative amounts of hydrogen and the at least one other material of the gas blend or mixture are selected in accordance with the nature of the at least one other material and the requirements for hydrogen assisted combustion.

25 4. A method according to claim 1 in which the gas blend or mixture is produced by a hydrogen generator characterised in that the non hydrogen components of the gas produced by the hydrogen generator do not all require full removal prior to combustion of  
30 the gas in a compression engine using hydrogen assisted combustion but that the gas blend or mixture containing the other component or components can be used as a fuel or fuel additive.

5. A method according to claim 1  
35 characterised in that the at least one other material is

selected from the group consisting of: oxygen, nitrogen, water, ethanol, carbon dioxide, carbon monoxide, hydrocarbons, methanol, methane or combinations thereof.

5 6. A method or apparatus according to claim 5 characterised in that the hydrocarbon material produced in the hydrogen generator is a paraffin or paraffin-like hydrocarbon containing saturated bonds.

10 7. A method according to claim 6 characterised in that the hydrocarbon is a  $C_1$ - $C_{20}$  hydrocarbon or a combination thereof.

15 8. A method according to claim 7 characterised in that the methanol, methane or similar materials produced in combination with the hydrogen gas are produced from a fuel material such as diesel, petrol, canola oil or the like.

20 9. A method according to claim 1 characterised in that operation of the hydrogen generator is adjusted to produce a desired ratio of hydrogen to the at least one other component in the gas mixture or blend formed by the hydrogen generator.

25 10. A method according to claim 1 characterised in that operation of the hydrogen generator is adjusted by altering parameters including one or more of the following, the composition of the materials introduced to the hydrogen generator, the velocities of gases of the various components, the temperature of operation of the hydrogen generator, the pressure of operation of the hydrogen generator, the velocity of gas being passed through the generator, the catalyst being used in the generator, the amount of exposure of the reactor to the catalyst, the type of hydrogen generator used, the nature and composition of the other component produced simultaneously with the hydrogen, the amount of cooling of the gas blend before it is introduced into the engine.

35

11. A method according to claim 1 characterised in that the hydrogen generator is operated at a pressure of from about 1-5 bar.

12. A method according to claim 1  
5 characterised in that the catalyst used in the hydrogen generator is selected from the group consisting of: nickel, platinum or materials containing nickel or platinum or combinations thereof.

13. A method according to claim 1  
10 characterised in that the gas mixture or blend is added directly to the engine or indirectly to the engine after cooling.

14. A method according to claim 1  
15 characterised in that the gas mixture or blend is added to a mixing chamber prior to being introduced into the engine.

15. A method according to claim 1  
20 characterised in that the gas blend or mixture is added in combination with one or more other components of the fuel for the engine.

16. A method according to claim 1 in which the fuel for the compression engine is introduced to the engine separately from the hydrogen containing gas blend or mixture required for hydrogen assisted combustion.

17. A fuel system for a compression engine  
25 characterised in that the system comprises a hydrogen containing gas generator for generating a hydrogen gas blend or mixture containing hydrogen and at least one other material at a first temperature, a heat exchanger  
30 for reducing the temperature of the hydrogen gas blend or mixture from the first temperature to a second temperature by passing the gas blend or mixture through the heat exchanger prior to introducing the gas blend to the engine wherein the gas blend forms the fuel or one  
35 component of the fuel for the engine and wherein the

relative amounts of the hydrogen and of the at least one other material of the gas blend or mixture are selected in accordance with the nature of the at least one other material and the requirements of hydrogen assisted  
5 combustion within the engine.

18. The system of claim 17 characterised in that the hydrogen generator is selected from the group consisting of: an electrolysis apparatus, a fuel cell, a fuel processor, a reformer, a cold fusion apparatus or  
10 other apparatus for producing hydrogen along with one or more other materials.

19. A method according to claim 18 characterised in that the hydrogen generator is a reformer operated at a temperature of from 100°C-1000°C.

20. The system of claim 17 characterised in that the fuel cell is selected from the group consisting of: a proton exchange fuel cell, a solid oxide fuel cell, an alkaline fuel cell, a direct methanol fuel cell, a molten carbonate fuel cell, a phosphoric acid fuel cell  
15 or a regenerative fuel cell.

21. The system of claim 17 in which the hydrogen generator is a reformer in which steam is used to heat a fuel as it passes over a catalyst provided in the hydrogen generator to produce the hydrogen together  
20 with the at least one other material to form the gas blend or mixture in the form of a reformat gas.

22. The system of claim 21 characterised in that the fuel and steam are cracked by passage through the hydrogen generator to form the reformat gas or  
25 hydrogen containing gas blend or mixture.

23. The system of claim 21 characterised in that the reformer reforms a hydrocarbon fuel including petrol, diesel, gasoline or the like to the reformat gas or hydrogen containing gas blend or mixture with the aid  
30 of steam.

24. The system of claim 17 characterised in that the compression engine is a diesel engine.

25. The system of claim 17 characterised in that the system includes one or more heat exchangers to  
5 cool the gas blend or mixture or to cool the gas being recycled to the hydrogen generator.

26. The system of claim 17 characterised in that the fuel is diesel fuel, petrol, gasoline or kerosene.

10 27. A fuel capable of being used for hydrogen assisted combustion of an engine characterized in that one component of the fuel is a hydrogen containing gas comprising hydrogen and at least one other material that is produced by a hydrogen generator along with the  
15 hydrogen during the hydrogen generation process, wherein the relative amounts of the hydrogen and the other material or materials are selected in accordance with the nature of the other material or materials and the requirements of the engine for hydrogen assisted  
20 combustion.

28. A hydrogen containing gas blend or mix suitable for use as a fuel or fuel additive or one component of a fuel characterised in that the gas blend or mix contains hydrogen and at least one other component  
25 in addition to hydrogen in which the other component is produced substantially simultaneously with the hydrogen by a hydrogen generator in which the relative amounts of the hydrogen and the other component is selected in accordance with the nature of the other component and the  
30 requirements of the engine for hydrogen assisted combustion within an engine to which the gas blend or mix is introduced.

29. The gas blend of claim 28 in which the gas blend or mixture is produced by a hydrogen generator  
35 characterised in that the non hydrogen components of the

gas produced by the hydrogen generator do not all require full removal prior to combustion of the gas in a compression engine using hydrogen assisted combustion but that the gas blend or mixture containing the other  
5 component or components can be used as a fuel or fuel additive.

30. The gas blend of claim 28 characterised in that the hydrogen gas blend or mixture produced by the hydrogen generator contains from about 0-50% by volume of  
10 hydrogen.

31. The gas blend of claim 28 characterised in that the gas blend or mixture includes from about 0-25% by volume of carbon monoxide.

32. The gas blend of claim 28 characterised  
15 in that the gas blend or mixture includes up to about 5% by volume.

33. The gas blend of claim 28 characterised in that the amount of carbon dioxide contained in the gas mix or blend is up to about 25% by volume.

20 34. The gas blend of claim 28 characterised in that the gas blend or mixture contains the balance of nitrogen.

35. The gas blend of claim 28 characterised in that the ratio of individual components in the gas  
25 blend or mixture is controlled to be a preselected amount is accordance with the requirement of hydrogen assisted combustion for the particular component.